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ABSTRACT

Job opportunities in the field of solar energy will increase steadily in Texas during the next few years as indicated by a survey of ninety-nine businesses currently involved in the solar industry. In 1979 the industry will need 108 installers/repairman and 17 technicians, while by 1983 it will need 260 installers/repairmen and 114 technicians. Average annual starting salaries will be $11,725.56 for installers/repairmen and $13,905.56 for technicians. To meet these needs various forms of training and education must be developed throughout the state. Adult and continuing education programs should provide courses to upgrade conventionally trained heating and air conditioning technicians in solar applications. One-year certificate programs should be instituted to train installers of solar energy units, while two-year associate degree programs are needed to train technicians. Colleges that undertake the implementation of such programs should consult advisory boards of potential employers to aid in program planning. Federal funding should be used to assist the developing and administering of these programs. (ELG)

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ED158010

A FEASIBILITY STUDY
FOR
SOLAR TECHNOLOGY

Texas State Technical Institute
Research Division
Waco, Texas

April 26, 1978

CE 017 304

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SUMMARY OF
A FEASIBILITY STUDY FOR
SOLAR TECHNOLOGY

Date: April, 1978

The number of jobs to exist in 1979:
108 installers/repairmen
17 technicians

The number of jobs to exist in 1983:
260 installers/repairmen
114 technicians

Starting pay: $11,725.56 for installers/repairmen
$13,905.56 for technicians

Enrollment potential: 444

CE 017 304

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STATE OF THE TECHNOLOGY

Texas leads the nation not only in the production of energy, but also in energy consumption. U.S. Representative Bob Krueger of New Braunfels has pointed out that the state of Texas consumes more energy for industries and utilities than New York, New Jersey, Pennsylvania, Ohio, Illinois, Indiana, Michigan, Washington, Oregon, California, and all of the New England states combined. Approximately 11% of Texas' total energy requirement is for heating, ventilating, and air conditioning. Between one-half and three-fourths of the total demand by industry is for process steam or heat.

Historical data suggests that it typically has taken approximately sixty years for a transition to a new energy resource to reach its peak use and subsequently decline. The oil and gas industries seem to have reached their 60-year peaks. Therefore, it becomes important now to plan for a transition to some new sources of energy to supply upcoming demands.

Solar energy is one major resource which represents an essentially inexhaustible source of energy if the technology to utilize it can be perfected. The potential for its use is considerable, but significant problems remain to be solved in its development. Contemporary solar technology represents a major candidate for meeting future energy needs by the year 2000.

The United States Energy Research and Development Administration (ERDA) has identified national priorities for research and development. The 1985-2000 priorities include:

(a) To increase the use of under-used fuel forms, such as solar energy for heating and cooling.

A long-term priority for beyond 2000 is:

(b) To pursue vigorously those candidate technologies which will permit the use of essentially inexhaustible resources: i.e. solar electric energy from a variety of technological options.

These priorities reflect ERDA's determination to make changes in the nature and scope of the nation's energy program to:

(1) include the solar electric approach among the inexhaustible resource technologies to be given high priority. This technology is to be given priority comparable to fusion and the breeder-reactor.

(2) increase attention to under-used new technologies that can be rapidly developed. Solar heating and cooling is close to implementation and promises a significant impact for the period 1985-2000.

It is projected by the Texas Energy Advisory Council that Texas' use of solar electric technologies will likely exceed the national average in future years. A determination has also been made that large areas of Texas are among the best areas of solar radiation in the United States. "It is therefore recommended that the State support and encourage the development of these resources and technologies by federal programs in Texas; ... and that training needs be monitored through state universities and colleges for needed installation and service technicians," (The Governor's Energy Advisory Council, Feb. 1977).

GLOSSARY

The U.S. Energy Research and Development Administration established the following definitions:

(1) solar electric - the development, design, construction, and operation of systems to collect the radiant energy of sunlight and transform the energy into electrical power. The technology includes the use of various collector systems, such as mirror concentrators, as well as various conversion systems such as photovoltaic devices. The technology also includes the use of solar-derived energy, such as wind or ocean thermal gradients, as an energy source for the production of electricity.

(2) solar heating and cooling - the design, construction, and operation of systems to utilize and/or store the radiant energy of sunlight for comfort control of buildings and houses and/or to provide heated water for household, industrial, or agricultural use.

Various titles found during the research for this project include:

(a) Solar Energy Technology
(b) Solar Engineering Technology
(c) Solar Energetics Technology
(d) Solar Electric Technology
(e) Solar Heating and Cooling Technology

PROJECTED JOB REQUIREMENTS

Nationwide

Navarro College in Corsicana conducted a study of solar energy job opportunities and published the following findings. By 1980 the estimate of manpower demand for solar energy installers and technicians in residential sectors alone is over 25,000.

It is estimated that for the United States to meet the projected demands, approximately 500 colleges will need to be involved in training solar technicians by 1980. A nationwide survey conducted by John Doggette of Oak Ridge Associated Universities in Tennessee of 1,152 community colleges indicated that only one college had an existing program in solar technology as of October, 1976. Only 30 community colleges had a program in the planning stages. Approximately 150 of the colleges had existing programs in heating, ventilation, and air conditioning which could adopt a solar option.

Statewide

On February 14, 1978, questionnaires were mailed to 99 businesses currently involved in the solar industry. These businesses were identified by means of advertisements in solar engineering magazines and lists of involved persons serving on advisory committees in the state of Texas. The accompanying cover letter requested that the form be returned by February 20, 1978. A copy of the letter and questionnaire are included in attachment I.

During the period allotted for return of the questionnaires, four were returned as undeliverable as addressed. Of the 95 remaining questionnaires, which are assumed to have been delivered, a total of 51 were mailed back by respondents. This results in an overall return rate of 53.68% which is high in relation to nationwide averages for return-rates on questionnaires.

The businesses contacted in the survey were assigned to one of seven categories according to the primary activity of the business in the solar industry. The respondents provided this information on the questionnaire. For non-respondents, this information was obtained from the National Solar Heating and Cooling Information Center, Rockville, Maryland. A breakdown of the categories and returns from each is given in the appendix, Table 1.

The data received in the survey was divided into four separate projections:

1979 Installers/Repairmen
1983 Installers/Repairmen
1979 Technicians
1983 Technicians

The results are that in 1979, 108 installers/repairmen and 17 technicians are expected to be needed in Texas. By 1983, 260 installers/repairmen and 114 technicians are projected. (See appendix, Table 2). For the specific methodology employed, see attachment I. In order to correctly interpret these results, it is imperative that the underlying assumptions be included in the consideration of the figures. These assumptions and their implications for this study are included in attachment I.

The nature of the linear regression technique does not allow for significant growth of the industry to be included in the projections. Therefore, this subject was treated separately in the analysis of the data. While specific numbers of employees to be needed cannot be projected, it is possible to predict whether a new company will be likely to hire solar-trained personnel, given the category into which the company will be classified. The predictions of the need for installers/repairmen show that a need will exist in all of the businesses involved in installation, one out of every four consulting firms, one out of every three manufacturing companies, one-half of all research offices, one out of every nine engineering firms, and two out of every three sales outlets. (See appendix, Table 3). The predicted need for technicians are that a need will exist in over half of all installation concerns, one out of every twelve manufacturing companies, one-half of all research offices, two out of every nine engineering firms, and four out of every nine sales outlets. (See appendix, Table 4). For the specific methodology used see attachment I.

STARTING SALARIES

The survey conducted by T.S.T.I. provided data on estimated starting salaries. Each company was asked to indicate on the questionnaire at what approximate salary it would hire installers/repairmen and technicians. The results were averaged within each category and then overall. The overall average for installers/repairmen was $11,725.56 per year; and for technicians the average was $13,905.56 per year. A breakdown by category is included in attachment I.

EXISTING TRAINING FACILITIES

A discussion with Dr. Roland Benson of the Texas Education Agency, Occupational Education and Technology Department on February 13, 1978 revealed that there are no approved programs in solar energy technology in the state. Likewise, no formal requests for approval have been submitted to the agency. Some existing air conditioning programs have incorporated a few solar devices into their training programs especially in the area of plumbing and pipe fitting. Richland College has offered an adult and continuing education series as an introduction to solar energy for approximately forty professional people. These two situations seem to be the extent of vocational solar education in Texas.

Dr. Benson indicated that in approving programs, the agency will adhere strictly to the guidelines presented in the Educational Amendments of 1976:

"104.543 Energy Education

(b) Funds available under section 120 may also be used to make grants to post-secondary educational institutions to carry out programs for the training of individuals needed for the installation of solar energy equipment, including training necessary for the installation of glass-paneled solar collectors and of wind energy generators, and for the installation of other related applications of solar energy."

EDUCATIONAL NEEDS

A study conducted by the Navarro Junior College identified three areas of need for education in solar energy. First, there is an immediate need for adult and continuing education programs to upgrade conventionally trained heating and air conditioning technicians and others in solar applications. Second, in order to meet the needs to approximately 1985, there need to be one-year certificate programs to train people to work as installers of solar energy units. Third, there need to be two-year associate degree programs to train technicians toward the post-1985 need for solar technology.

An industrial survey conducted in the Houston-Gulf Coast area supported the above opinions. A percentage of 83.7 of the respondents indicated that they thought that continuing education would be beneficial in training the existing work force. Also, 56.8% felt that an associate degree was the appropriate level of training for technicians. They indicated that the most important fields of support study for a technician would be computer science, chemistry, and mechanical technology.

Further support of the above opinions was provided by participants of the Energy Technology Training Conference which met in 1976. The college participants and industry representatives together made the following recommendations:

1. Supply and demand manpower information for the solar sector must contain information on specific job categories by region in order to benefit any education institution planning a solar program.

2. An association of persons interested in solar technology training should be established and meet periodically to disseminate systematically relevant materials.

3. Most colleges interested in solar technology should consider supplementing their HVAC (air conditioning) or building construction programs for training entry-level students and providing upgrading courses for employed technicians.

4. Advisory boards comprised of potential employers of graduates are essential to each college in program planning.

5. Industry-wide support of education institutions in training program development and implementation is presently needed and will become even more important in the future.

6. With the recognition that 2-year associate degree programs in solar technology are not needed immediately, Federal funding for curriculum development should be contracted to provide adequate time for planning and implementing quality programs. A first condition for funding should be that the project results will benefit all education institutions interested in solar technology.

7. The implementation of a comprehensive associate degree solar program should not take place without reasonable assurances that the graduates can be placed.

POTENTIAL ENROLLMENT

The Career Characterizing and Reporting System developed by Texas State Technical Institute indicates that of 6,854 students interviewed in 1976, 1,003 plan to attend a junior college or technical institute. An additional 1,218 students were undecided.

The system does not include a choice for solar technology; therefore, the most closely allied fields of air conditioning, mechanical technology, and chemical technology are considered as the possible drawing places from which students may come. These three fields represent a potential student population of 444 students. For a complete breakdown of the occupational choices and geographic locations of these potential students see the appendix, Table 5.

APPENDIX

TABLE 1
Responses to Solar Survey

Category	Total in Texas	Contacted	Responded	Per Cent Return
Installation	22	9	7	77.77
Manufacturing	38	31	11	35.48
Research	10	8	6	75
Consulting	8	6	4	66.66
Engineering	18	10	9	90
Sales	96	14	9	64.28
Other	51	6	5	29.41
Unknown		11		
Total	243	95	51	53.68 overall

(Texas State Technical Institute, 1978).

TABLE 2

Manpower Demand

Category	1979 Installers/ Repairmen	1983 Installers/ Repairmen	1979 Technicians	1983 Technicians
Installation	13.86	53.43	0	22
Manufacturing	15.55	27.64	5.18	6.91
Research	5	9.17	3.33	13.33
Consulting	4	4	0	0
Engineering	0	5	8	29
Sales	64	160	0	42.66
Total	107.41	259.24	16.51	113.9

(Texas State Technical Institute, 1978).

TABLE 3

Probability of a New Business Needing Trained Solar Installers/Repairmen

Category	Need	No Need	Unknown
Installation	100%	0%	0%
Consulting	25%	75%	0%
Manufacturing	33%	50%	17%
Research	50%	33%	17%
Engineering	11%	78%	11%
Sales	67%	33%	0%

(Texas State Technical Institute, 1978).

TABLE 4

Probability of a New Business Needing Trained Solar Technicians

Category	Need	No Need	Unknown
Installation	57%	43%	0%
Consulting	0%	100%	0%
Manufacturing	8%	75%	17%
Research	50%	33%	17%
Engineering	22%	67%	11%
Sales	44%	56%	0%

(Texas State Technical Institute, 1978).

TABLE 5

Occupational Choices of Students

	Region I Waco	Region II Harlingen	Region III Amarillo	Region IV Sweetwater	Total
Air conditioning & refrigeration					
(1) First choice	29	7	5	2	43
(2) Second choice	32	5	4	4	45
(3) Third choice	20	7	6	2	35
					123
Mechanical engineering or technology					
(1) First choice	71	4	16	8	99
(2) Second choice	44	5	8	8	65
(3) Third choice	41	6	7	6	60
					224
Chemistry, chemical engineering or technology					
(1) First choice	29	1	6	1	37
(2) Second choice	23	2	6	1	32
(3) Third choice	23	2	0	3	28
					97

Grand Total 444

(Texas State Technical Institute, 1977)

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ATTACHMENT I

SOLAR MANPOWER DEMAND SURVEY

TEXAS STATE TECHNICAL INSTITUTE

JAMES CONNALLY CAMPUS
WACO, TEXAS 76705
817 799-3611

OCCUPATIONAL and
EDUCATIONAL RESEARCH

February 14, 1978

Mr. Ben McCollum
McCollum Construction
Solar Energy Systems
San Marcos, TX 78665

Dear Mr. McCollum:

The Research Division of Texas State Technical Institute is conducting a feasibility study on the job opportunities for solar energy installers/repairmen/technicians. It would be of great benefit to us if you would please complete the enclosed form and return it to us by approximately February 20, 1978. There is no published data available on this information, so you will be our only source of reliable projections.

Thank you very much for your assistance in this project.

Sincerely,

Sherry Williams

Ms. Sherry Williams
Coordinator of Research
Building 17-10

Enclosure

12/52

Solar Energy Employment Projections

February 10, 1978

1. In what way is your company involved in the solar energy industry? (i.e., installation, engineering, consulting, manufacturing).

_____

_____

2. Do you anticipate hiring a one-year graduate (installer/repairer) within one year? _____, five years _____? If yes, approximately how many _____? Do you anticipate hiring a two-year graduate (technician) within one year? _____, five years _____? If yes, approximately how many _____?

3. If you do anticipate hiring any of the above, at what approximate starting salary?

_____

_____

4. If you would like a copy of the results of this state-wide study, please check here ____.

5. It is optional for you to identify your company; however, it would be beneficial for us to know who you are if possible.

_____

_____

_____

Table 5

TABULATION OF RESPONSES
FROM SOLAR SURVEY

Type of Business	Number of Responses	Projected Need Installers/Repairmen		Average Annual Starting Salary	Projected Need Technicians		Average Annual Starting Salary
		1979	1983		1979	1983	
Installation	7	6	17	$10,613.33	0	7	$12,900.00
Consulting	4	2	2	Negotiable	0	0	N/A
Manufacturing	11	4.5	8	$ 6,240.00	1.5	2	$ 8,400.00
Research & Design	6	3	5.5	$ 9,600.00	2	8	$14,400.00
Sales	9	6	15	$10,300.00	0	4	$11,600.00
Engineering	9	0	2.5	$18,000.00	4	14.5	$15,333.33
Other	5	0	0	$15,600.00	0	0	$20,800.00
Total	51	21.5	50		7.5	35.5	
Overall Average	53.68%			$11,725.56			$13,905.56

(Texas State Technical Institute, 1978)

COMMENTS

The survey prompted the following comments from some respondents:

Question #

2. We need technicians who understand hydronics, valves, and a little electricity.

   We also have one hand employed now that we would like to have enrolled in a night school situation.

   We primarily train our own people.

   No, but we expect our dealers to hire many. We will hire a person in approximately 3 to 5 years for sales of solar equipment.

3. Negotiable - probably will train own A/C technicians. Minimum wage for laborer - unskilled level - we have to train.

   Open at this time but will be commensurate with skills and personality.

   We have internal 2 year training program. Begin salary $700.00 month plus employee must further his education at night (we pay tuition and books).

5. If our "guiding fathers" and Governor Carter would get on with the tax incentives and FHA would come out of their doldrums and make financing possible the sky should be the limit for (questions) 1 and 2 above.

   Since we are a manufacturer we have no requirement for installers or repairers.

   As a manufacturer only, we do not install or service. This is done by authorized contractors.

We presently employ 3-4 service people who install and service solar panels in connection with their regular activities.

Note: that Navarro College, Corsicana has a large program to develop a practitioners curriculum and has done a survey already of needs in this area. Contact Mike Lowenstern, Navarro College.

METHODOLOGY

The methodology used to project manpower needs was that of linear regression. Linear regression has plausibility for short-term forecasting; and linear extrapolation over a short period of time can be considered an approximation to the unknown nonlinearity in question. (Morton, 1968). The method of linear regression uses facts, knowledge, and information of the present to predict the future.

The data obtained in the survey fit the three conditions noted above, namely:

1) short-term forecasting - 5 years in this case,

2) unknown nonlinearity-attempts were made to model the curve for powers of the equation from 2 through 9, to approximate the curve exponentially, and to fit an irregular model to the curve; all of which attempts failed, and

3) facts, knowledge, and information of the present - were available to the researcher. Therefore, the decision to use a linear model is deemed as appropriate.

The model used in each of the four prediction cases was:

$$y = B_0 I + B_1 C + B_2 M + B_3 R + B_4 E + B_5 S$$

where I = Installation
C = Consulting
M = Manufacturing
R = Research
E = Engineering
S = Sales

The procedure provides the respective B-weights for each category. When each B-weight is considered in relation to the number of businesses known to exist within the state the result is the projected need anticipated for each category.

The method of linear regression makes certain assumptions which must be considered when evaluating the results of the projections. These assumptions and their implications for this study are included in the next section.

The methodology used to predict the chance of a new business participating in the hiring of solar trained employees was to construct a contingency table of cross-classifications of the data. The count data entered in the contingency table was then converted to probabilities.

ASSUMPTIONS

The assumptions necessarily associated with the use of linear regression are:

1) The present is a point of continuity and the future behavior of the technology area will resemble past behavior, and

2) The specific constellation of forces influencing growth over the recent past will continue its influence in the future, possibly with some marginal modifications. (Connors, 1978).

The implications for this study are:

1) The assumption of continuity does not account for the tremendous growth of the solar industry as projected by the Solar Energy Industries Association. It is projected to grow at 200 to 300 percent per year. (U.S. Energy Research and Development Administration, 1976).

2) The assumption of no significant change in influencing forces does not account for the effect that would be produced by passage of the tax reform act to provide tax incentives for installing solar equipment.

Consequently, the projection equations used do not allow for the increase in demand expected to be created by the emergence of new businesses in Texas. Likewise, they do not allow for the increase in demand for installations expected to be created pending passage of the tax reform act.

These implications point out the fact that the projections provided herein are extremely conservative. In keeping with the conservative nature of the projections, the following assumptions were made concerning the data supplied in the survey:

1) A minimum value (.5) was assigned to those companies indicating no knowledge of whether they will need solar trained employees. This assumes the middle-of-the-road stand that some companies will need trained personnel while others may not.

2) A minimum value (1) was assigned to those companies indicating a need for solar-trained employees, but indicating no knowledge of the number that will be needed.

3) All responses from the "other" category indicated no need. Consequently, in assuming this was a representative sample of the businesses which would fall in this category, the "other" category was omitted from final computations.

One criticism of the survey technique for data gathering is that the non-responders to the survey constitute a biased group. This predicts a skewness in the data gathered from the responders. An analysis of the return rate within each category (see appendix, Table 1) shows that the "other" and "manufacturing" categories are the only areas without what can be considered extremely high response rates. As noted previously, the entire response from the "other" category indicated no need; and the responses from "manufacturing" indicated a 67% probability of no need or at best unknown.

If this represents a skewed sample, as purported, then the skewness appears to be toward zero. This again points to the conservative nature of the projections.

ATTACHMENT II

SOURCES OF ADDITIONAL INFORMATION

National Solar Heating and Cooling
Information Center
P.O. Box 1607
Rockville, Md. 20850
Toll free number: 800/523-2929

Solar Engineering Magazine
8435 N. Stemmons Freeway
Suite 880
Dallas, Tx. 75247
Phone (214) 630-6963

Texas Solar Energy Society
1007 S. Congress
Suite 348
Austin, Tx. 78704